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ABSTRACT

Many useful diagnostic procedures and therapeutic exercises associated with cognitive therapy can be conducted with a popular interactive computing system such as that in use at Bellevue Hospital. When purchasing a computer for this purpose versatility and availability of software, serviceability, modularity, and speed are factors to take into consideration. Other factors include color, graphics, program storage, and memory. Computer programs are available that are designed specifically to test and treat both perceptual and memory dysfunction, and commonly available programs such as Target Practice, Space Invaders, and Towers of Hanoi can also be used. A description of the treatment of a motorcycle accident victim provides a clinical example of the use of microcomputers as an adjunct to treatment. (MER)

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# USING MICROCOMPUTERS FOR COGNITIVE REHABILITATION

by

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Using Microcomputers for Cognitive Rehabilitation

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Brain injury, including that which follows a stroke, may severely and permanently impair mental function. Cognitive Rehabilitation is a growing interdisciplinary specialty which seeks to help afflicted persons in their return to work and re-entry into society. Computers can serve as valuable adjuncts in the rehabilitative process. Many useful diagnostic procedures and therapeutic exercises can be conducted conveniently with a popular interactive computing system costing under $3000.

Technical information about small computer systems is presented, based on the author's experiences in running the Cognitive Rehabilitation service at Bellevue Hospital. More than one hundred brain-injured individuals have had contact with a small computer using one of the 500 programs in the unit's library. Many of these programs, written for other purposes (education and/or recreation mostly), can be very helpful in ways that are both expected and unexpected. Finally, a series of Computer Programs for Cognitive Rehabilitation will be

introduced. Emphasis is on the use of the computer as an adjunct to, and not as a substitute for, treatment.

I. What to look for in a Microcomputer?

1. Versatility and availability of software. Buy a "Ford" not a "Saab." Much software is available from non-manufacturers. Check out such publications as Byte, Personal Computing, and the TRS-80 Sourcebook.

2. Serviceability. Is it near? Are the service policies helpful? Will they provide a temporary "loaner" while your unit is being repaired? For non-engineers it is better to pay more to a dealer who will provide service and technical advice than to an inexpensive mail order vendor.

3. Modular vs. complete unit? A modular system enables you to substitute a larger monitor to get an enlarged display. You can also position the keyboard to meet the needs of physically disabled persons. Finally, with a modular unit you can substitute components for ease in repairs. Modular units are more portable - which can be either an advantage or a disadvantage, depending on who is walking off with it!

4. Speed is important in some respects and not in others. Speed is essential for rapidly bouncing balls and missiles, as well for simultaneous appearance of displays. However, little is lost if the system needs 20 seconds to prepare for a session - explanations and discussions easily fill the void.

5. Color is attractive, but resolution may be poor and the monitor is much more expensive.

6. Graphics. High resolution graphics may slow your system, as appears to be the case on the Exidy Sorcerer, and do not greatly increase the computer's usefulness.

7. Cassette vs. disk. Cassettes are inexpensive devices for storing programs and other information. However, they are frustratingly slow and may be unreliable - a poor combination of factors. A second disk facilitates copying of whole diskettes, a procedure which is essential for software dependability.

8. Memory. Begin with 16 K for cassette systems and 32 K for disk systems. You can usually add more.

II. Programs (Software)

A. Structured programs are typically used in a formal therapeutic session. The Computer Programs for Cognitive Rehabilitation, available from Life Science Associates, Bayport, N. Y. 11705, contain programs for testing and treating both perceptual and memory dysfunction.

The perception programs are:

Reaction Time Measure of Visual Field (REACT)

Search for Shapes (SEARCH), and

Speeded Reading of Word Lists (SRWL).

The memory programs are:

Free Recall (FREEREC)

Memory Span (SPAN)

Triplet Recall (TRIPREC), and

Sequence Recall (SEQREC).

Utility programs are:

Patient Log (LOG) and

Visual Angle (VISANGLE).

B. Unstructured. Many programs can be used or adapted for Cognitive Rehabilitation, including games and educational routines. These may be used independently, including use at home. Programs written in BASIC can be modified by non-professional programmers. Examples of programs which tend to challenge perception are: Target Practice, Space Invaders, Tic-Tac-Toe, Checkers, Math (if the problem is presented in vertical format), and Maze solution. Programs which are useful for memory exercise are: Concentration, Towers of Hanoi, Mastermind, and some versions of Hangman. Educational programs are blossoming these days. IQ Builder contains number series problems and vocabulary drills. Radio Shack has a well reviewed mathematics series for grades K throuh 8, which might be useful for some patients. A reading series is forthcoming. The makers

of the Apple computer pride themselves on their educational programs. Finally, one must not overlook the programs which teach you how to program in BASIC. Step-by-Step is an excellent one, as is Radio Shack's.

III. Clinical Example.

A severe closed head injury in a motorcycle accident put a 23 year old airforce veteran in a coma for 3 months. A year an a half later, when we first saw him, he had plateaued on conventional rehabilitation therapies. Our evaluation at that time showed a variety of problems, the most severe of which was a memory deficit in the transfer of information for more permanent registration in long-term store. One hand was totally non-functional; the other was spastic and ataxic - adequate for use of a keyboard, but barely adequate for writing. This disability made it unrealistic to plan on notetaking to help remember things. Word fluency was low, reflecting a generally passive mode of functioning. Spelling was poor.

He was placed on a weekly program of therapy in the Cognitive Rehabilitation unit at Bellevue. Free recall was used every session. Memory Span and Triplet Recall were introduced subsequently as vehicles for training short- and long-term storage, respectively. Slow gains in long-term recall. have been observed as illustrated on Figure 1.

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Insert Figure 1 about here.

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These gains have been accompanied by dramatic improvements noted by his family and by our own staff.

This therapeutic program was augmented by practice at home, made possible because the patient and his family purchased their own computer. Our first objective was to engage the patient's interest, so we gave him a set of game programs, including the Towers of Hanoi puzzle program (which he could do very well) and the game of Concentration. These were used with the LOG program, to facilitate record keeping and making notes. The second objective was to have the patient learn to operate the computer and be able to use it independently. Both objectives have been met, as gauged by the patient's enthusiasm and his almost daily use of it for over 6 months. He uses it by himself, including the making of entries into the LOG. If he were to make no more progress, he would already have a vocationally relevant skill. In addition to anticipated benefits, there has been a marked increase in initiative and verbal fluency. This is most evident to us in the commentary which is now offered on the LOGs; it has also been noted by his family. Examples of early and late LOGS are given for illustration.

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Insert Figure 2 about here.

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to the use of the computer because it continually requires a person to make choices and to exert preferences.

Advantages. For clinical use, the advantages of the microcomputer are many, including a high degree of flexibility. A wide variety of procedures are readily available. The computer is a masterful information processor and, thus, complements patients' needs for therapy in this area. To the extent that cognition is information processing, the match can be ideal. Added advantages, particular to the needs of work with brain injured patients, include the fact that the computer never runs out of patience, and learning how to use it can be vocationally relevant. The precision, reliability, and accuracy of the computer, together with its word processing and record keeping capabilities are undeniable assets too.

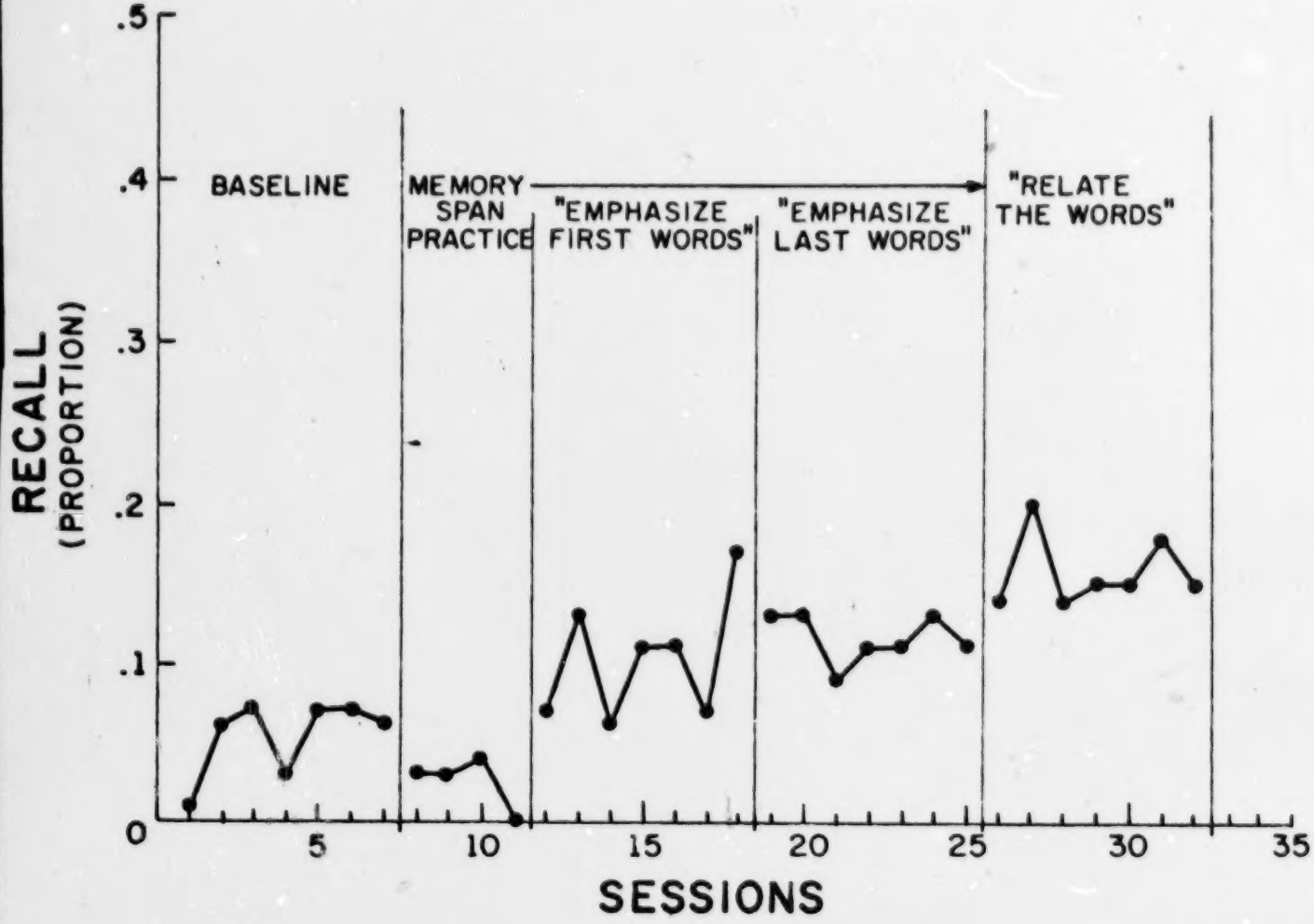


Figure 1. Recall of a severely head-injured reflecting a gradual progression towards improved registration in long-term store.

Gianutsos

Excerpt from LOG made 1 month after starting home computer program

```
Ø/3Ø/81 11:Ø4:4Ø
ON YESTERDAY I RAN TOWERS IN 144 MOVES
-------------------------------------------------------------------
Ø1/3Ø/81 11:Ø9:19
I RUN HANGMAN TODAY
---> PROGRAM: TICTAC
-------------------------------------------------------------------
Ø2/Ø2/81 15:11:24
---> PROGRAM: CONCENTERATION
---> PROGRAM: CONCEN
-------------------------------------------------------------------
Ø2/Ø2/81 15:56:58
IN CONCEN THREE TIMES AT BAT OUT OF 1Ø PAIR I MADE IT IN 22. 2Ø
AND WITHOUT A MISTAKE I MADE IT IN 16
---> PROGRAM:
-------------------------------------------------------------------
Ø2/Ø2/81 16:13:25
---> PROGRAM: MONOPOLY
-------------------------------------------------------------------
Ø2/Ø3/81 Ø5:Ø9:Ø3
---> PROGRAM: MULTDIV
-------------------------------------------------------------------
```

Excerpt from LOG made 3½ months after starting home computer program

```
-------------------------------------------------------------------
Ø4/Ø9/81 Ø9:29:15
---> PROGRAM: CONCEN
---> PROGRAM: CONCEN
-------------------------------------------------------------------
Ø4/Ø9/81 Ø9:43:ØØ
I BEAT THE BRAIN DAMAGED COMPUTER TEN TO ZERO. ON THE OTHER HAND
SHE SAID IF YOUR GOING TO GET COCKY AND BE A SMART ASS I AM GOING
TO TEACH THIS GUY A LESION
SHE BEAT ME SEVEN TO THREE
---> PROGRAM: TOWERS
-------------------------------------------------------------------
Ø4/Ø9/81 1Ø:13:17
I DID TOWERS IN 139 MOVES
---> PROGRAM: HANGMAN
-------------------------------------------------------------------
Ø4/1Ø/81 Ø8:48:Ø2
---> PROGRAM: TOWERS
-------------------------------------------------------------------
Ø4/1Ø81  Ø8;55:3Ø
DID TOWERS OF HANOI IN 132 MOVES.  I AM GETTING BETTER AT THIS //TO
-------------------------------------------------------------------
```

Figure 2. The LOG of a head trauma patient using a microcomputer for therapeutic exercise at home.